L1Calo Fiberplant Update WBS 1.3.3

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Schedule

- 2014:
  - Testing of components
  - Strawman design
- 2015:
  - Strawman designs for 2 options
  - Demonstrator fiber plant
  - End of the year: technology decision
    - Number and location of inputs available
    - Link speed decided
- 2016:
  - Fiber plant design
- 2017:
  - Fiber plant assembly/testing

Schedule

1.Feb.2014	fiber test equipment at MSU
1.Apr.2014	optical test bench set up
1.May.2014	strawman design input specification
1.July.2014	survey of available technologies
1.Sept.2014	component tests have started
1.Nov.2014	first strawman design available
1.Dec.2014	Preliminary Design Review (CERN)
15.Jan.2015	Passive Demonstrator Design
15.Feb.2015	Begin Building Passive Demonstrator
15.Mar.2015	Hubs Prototypes to MSU
1.May.2015	Start testing active splitter components
1.Jun.2015	Passive Demonstrator Complete
1.Aug.2015	Demonstrator fiber plant to CERN for prototype integration tests
31.Dec.2015	Engineering design specifications finalized for passive and active components (external)
1.May.2016	Strawman design with final components
1.Sept.2016	active and passive components validated
1.Nov.2016	Production readiness review (CERN)
1.Apr.2016	Production passive component design sent for manufacturing
1.Aug.2016	First set of active production components to MSU
28.Feb.2017	Complete set of all components at MSU
31.Jul.2017	Acceptance tests for all components complete
2.Oct.2017	Fiber plant ready to ship
1.Jan.2018	Fiber Plant ready to install
31.Jul.2018	Required in ATLAS for full system test

Fiber plant components

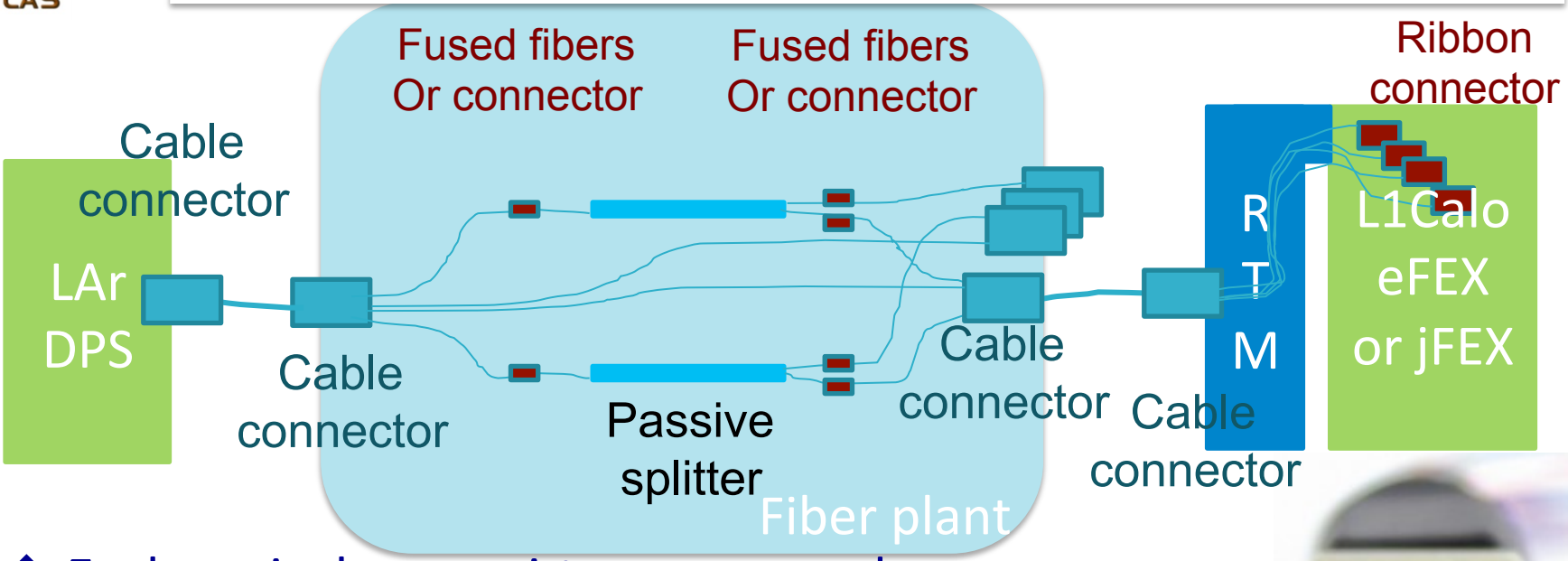
- Provide translation of fiber mapping from LAr and Tile to eFEX and jFEX
  - Trigger tower by trigger tower, super cell by super cell
- Provide duplication of some signals as required
  - Overlapping regions processed by different FEX cards
- Passive optical splitters provide 1→2 splitting
- Active splitting needed for corners and special places
  - Design and build custom modules to accomplish this
  - Require low jitter and low latency
- Alternatives to active splitters?
  - Careful mapping of fibers to transmitters to avoid empty transmitters?
    - Doesn't appear feasible
  - More powerful transmitters, more sensitive receivers?
    - Not available

Hardware cost

- Questions/assumptions:
  - Ribbon cables from LAr to fiber plant and from fiber plant to eFEX, jFEX not included
  - Fiber plant has input connectors and output connectors
- Fiber plant components
  - eFEX fiber plant mapping and passive splitting $160k
  - jFEX fiber plant mapping and passive splitting $96k
  - Numbers have not bee updated since Spring 2013 estimate
- Demonstrator, test fibers, connectors, splitters
  - $25k
- gFEX would require additional splitting and mapping
- Active splitter cards in jFEX or gFEX crate?

Backup slides

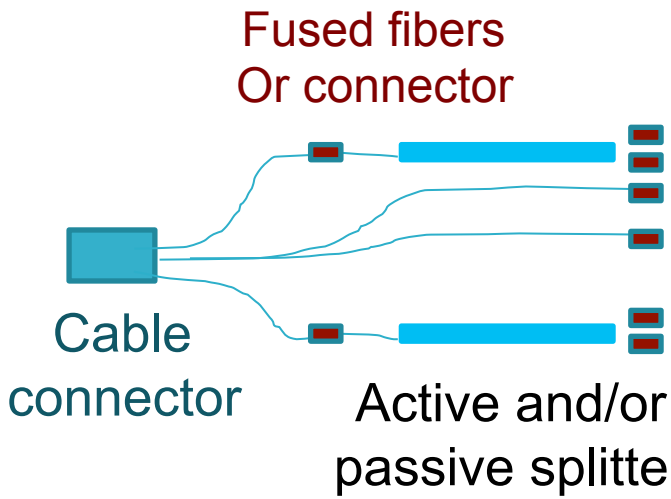
Fiber plant connections



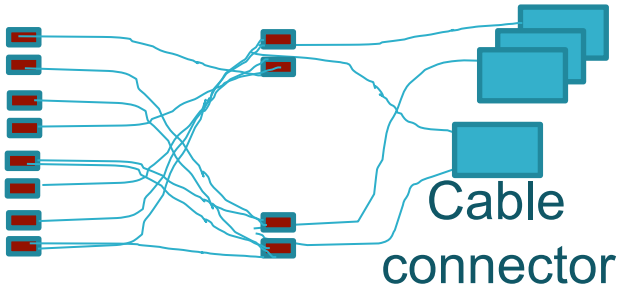
- Each optical transmitter connected to one 12-fiber ribbon
- Fiber ribbons are bundled into cables
  - Mapping required for eFEX, jFEX not the same as from LAr and Tile
- Passive optical 1→2 splitting for overlap regions of two sliding windows
- Active splitting required for fibers on corners

Staged mapping

Stage 1:
separate eFEX/jFEX
Active and passive splitting



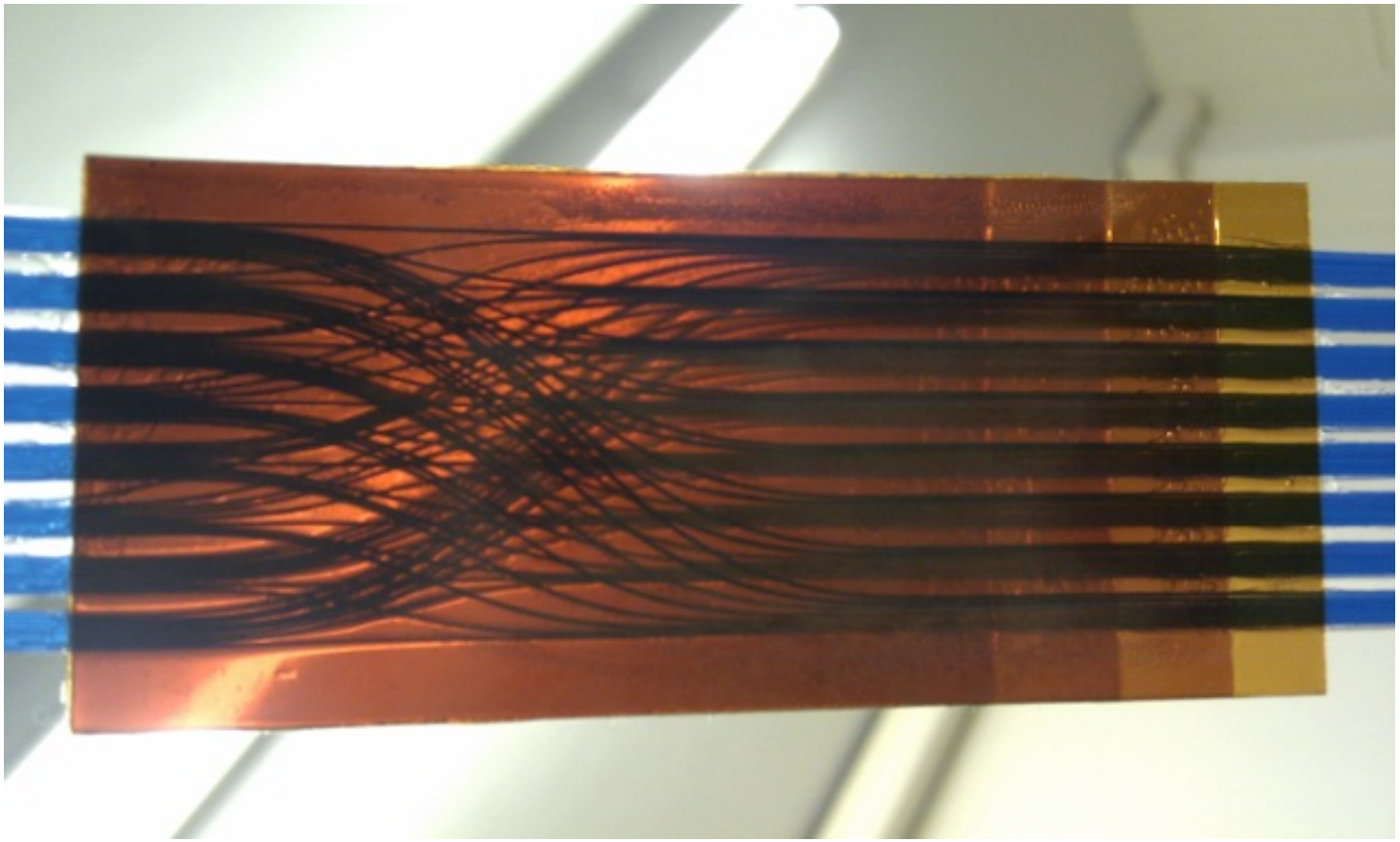
Stage 2:
Map to specific
eFEX/jFEX boards



- Each stage consists of small number of identical modules
  - Some exceptions likely necessary
- Connections commercial or by hand or both

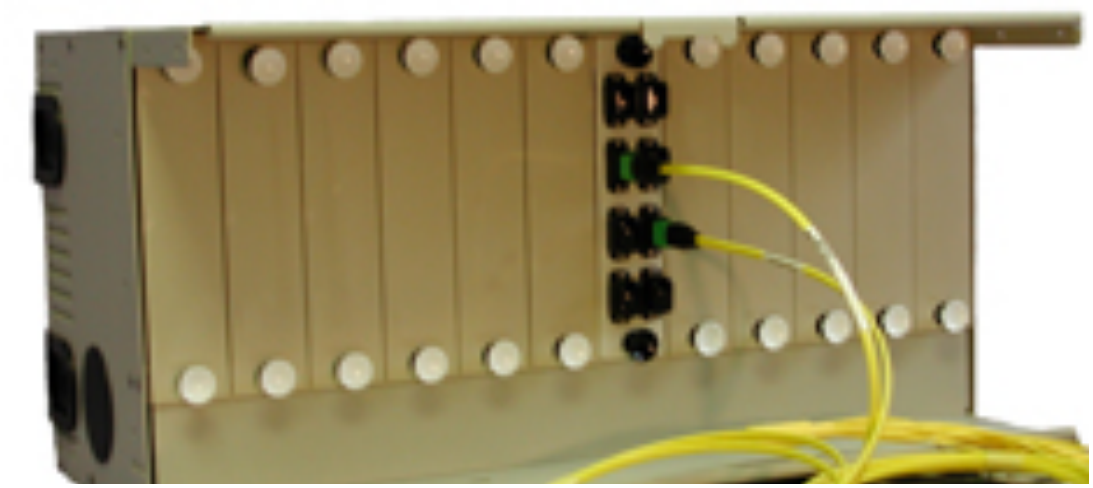
Commercial fiber mapping

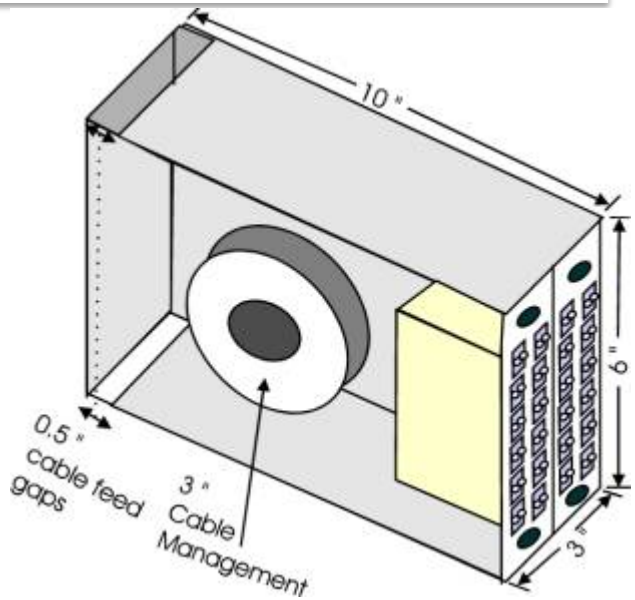
- Molex flex fibreplane



By-hand channel mapping

Fiber plant Enclosure





- Need rack space, front and back
- Not yet clear how much space is needed

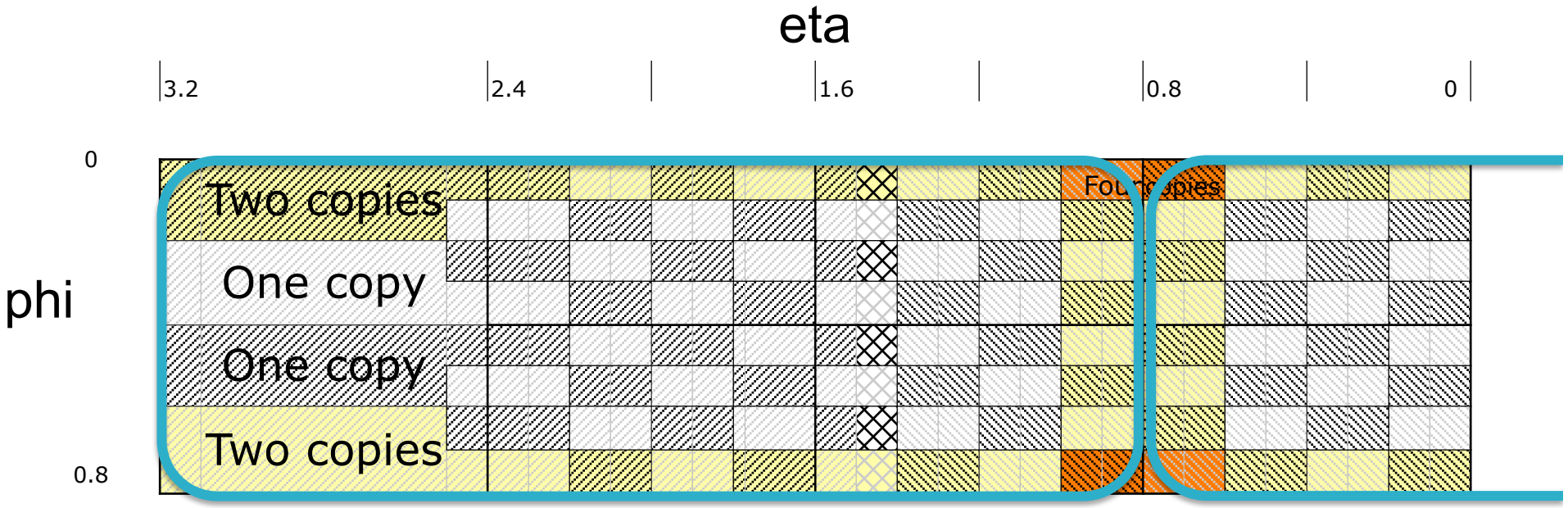
Active or passive splitting

- Current push in LAr is to have more DPS than needed
  - Duplication on DPS
  - Some mapping on DPS
- But DPSs are expensive
  - Could be cheaper to just buy splitters
- Active splitting required for 1→4
  - Commercial fiber repeater or splitter
  - Custom board with virtex 7 (40 inputs, 80 outputs)
    - Learn from HUB experience
    - Learn from jFEX, eFEX experience
- If running at 10 GB/s
  - Fewer fibers and different mapping
  - If lots of DPS and 10 GB/s → no splitting
- No decision can be made until LAr and Tile design finalized and link speed decided

Fibers to ribbons to cables

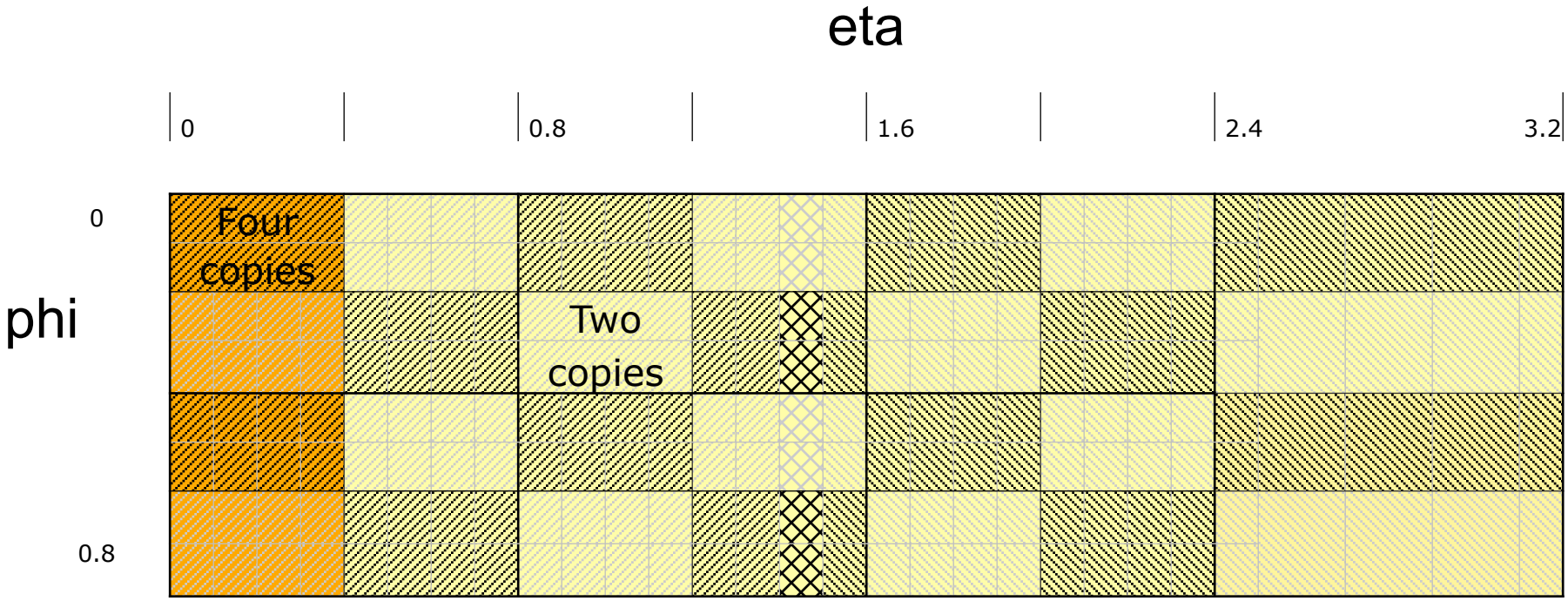
- LAr outputs:
  - To eFEX: Two towers per fiber (100 bits per tower, BCmux)
  - To jFEX: 8 towers per fiber (13 bits per tower)
  - Four ribbons are grouped into one cable
  - DPS modules wrap around phi for a fixed eta
- L1Calo inputs:
  - Six ribbons per cable
  - Adjacent etas for fixed phi processed on the same board
- eFEX: ~20 modules, each receiving ~200 fibers
- jFEX: 8 modules, each receiving ~70 fibers
- Require careful mapping of every fiber between connectors
- Signal sharing between different FPGAs on the same board is done electrically

LAr overlap regions - eFEX



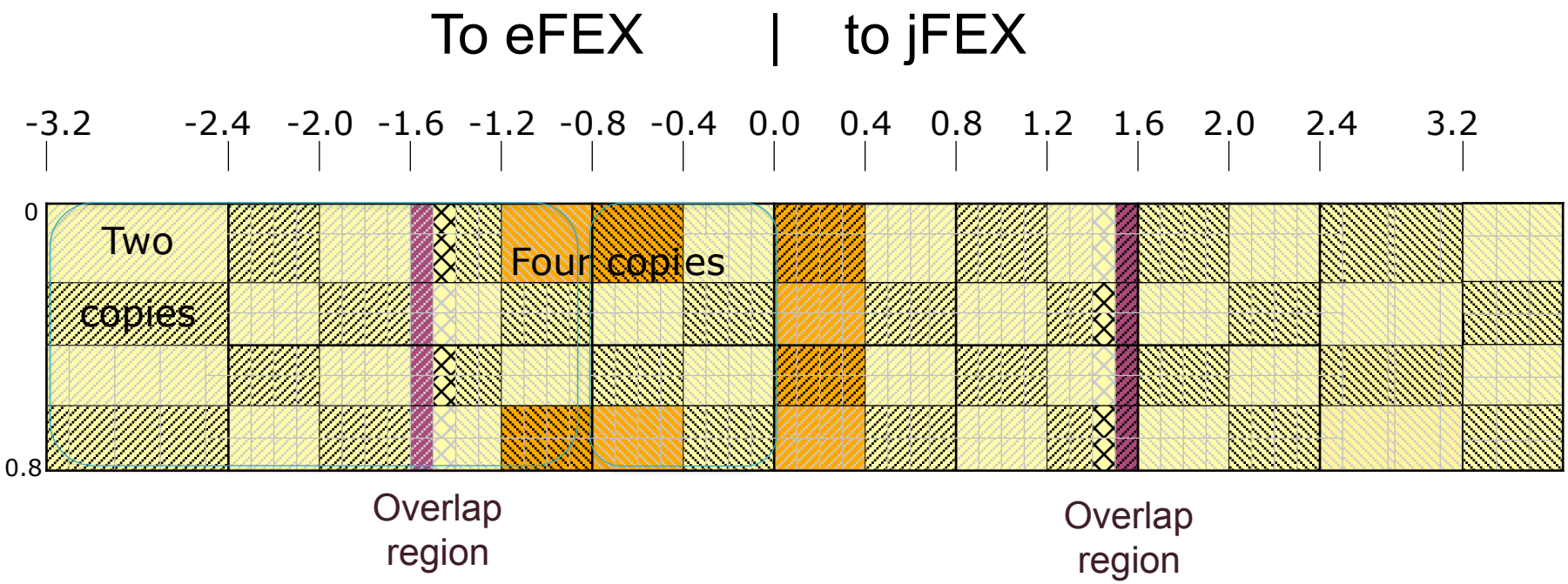
- Each shaded region corresponds to one fiber
- This image corresponds to two eFEX modules
  - one barrel (0.0 to 0.8 in eta), one endcap (0.8 to 2.4 in eta)
- Four copies of specific towers/super cells needed
  - EM barrel/endcap overlap region likely to have underused fibers

LAr overlap regions - jFEX



- This image corresponds to one jFEX module
  - Fewer jFEX fibers, but need four copies for the center of the detector
- Times 2 for full eta coverage
- Times 8 for full phi coverage

Tile overlap regions



- Each differently shaded region corresponds to one fiber
- One jFEX module for one side of detector (4 fibers in phi)
- Active splitting to send four copies where required
- Not yet decided how to handle overlap region

Material and Travel

- Fiber plant module cost ($256k) off-project
  - Fiber plant and passive splitters are commercial product
  - eFEX fiber plant $160k
  - jFEX fiber plant $96k
  - Only one final fiber plant each for eFEX, jFEX
  - Includes active splitter parts and devices
- No other material cost

- Travel for engineer Laurens is in WBS item 1.3.2.1
- Engineer Ermoline is based at CERN